Experiment No: 1 **Date:**

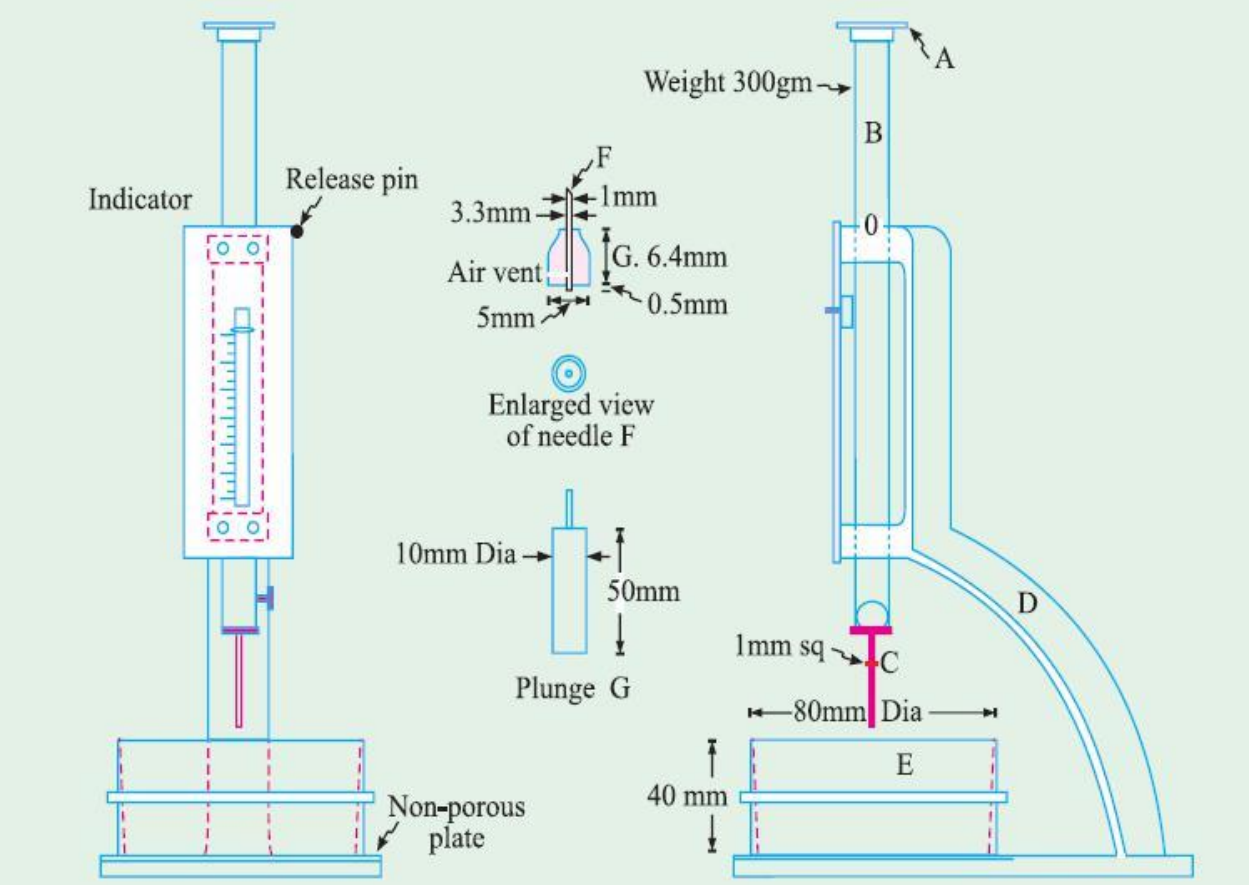
Title: Standard consistency of cement

Objective: To determine the normal consistency of a given sample of cement.

Reference: IS : 4031 (Pat 4) - 1988, IS : 5513-1976

Theory: For finding out initial setting time, final setting time and soundness of cement, and strength a parameter known as standard consistency has to be used. The standard consistency of a cement paste is defined as that consistency which will permit a Vicat plunger having 10 mm diameter and 50 mm length to penetrate to a depth of 33-35 mm from the top of the mould.

Figure:



Apparatus: Vicat apparatus conforming to IS : 5513-1976, Balance, Gauging Trowel, Stop Watch, etc.

Procedure:

1. The standard consistency of a cement paste is defined as that consistency which will permit the Vicat plunger to penetrate to a point 5 to 7 mm from the bottom of the Vicat mould.
2. Initially a cement sample of about 300 g is taken in a tray and is mixed with a known percentage of water by weight of cement, say starting from 26% and then it is increased by every 2% until the normal consistency is achieved.
3. Prepare a paste of 300 g of Cement with a weighed quantity of potable or distilled water, taking care that the time of gauging is not less than 3 minutes, nor more than 5 min, and the gauging shall be completed before any sign of setting occurs. The gauging time shall be counted from the time of adding water to the dry cement until commencing to fill the mould.
4. Fill the Vicat mould (E) with this paste, the mould resting upon a non-porous plate. After completely filling the mould, smoothen the surface of the paste, making it level with the top of the mould. The mould may be slightly shaken to expel the air.
5. Place the test block in the mould, together with the non-porous resting plate, under the rod bearing the plunger; lower the plunger gently to touch the surface of the test block, and quickly release, allowing it to sink into the paste. This operation shall be carried out immediately after filling the mould.
6. Prepare trial pastes with varying percentages of water and test as described above until the amount of water necessary for making up the standard consistency as defined in Step 1 is found.

Observation: Express the amount of water as a percentage by mass of the dry cement to the first place of decimal.

Sl. No.	Weight of cement (gm)	Percentage by weight of dry Cement (%)	Amount of water added (ml)	Penetration (mm)
1				
2				
3				
4				

Conclusion/Result: The normal consistency of a given sample of cement is _ _ _ _ %

Experiment No: 8 **Date:**

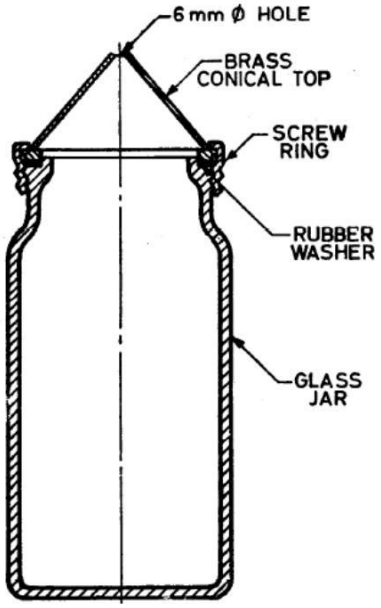
Title: Specific gravity of fine aggregates

Objective: To determine specific gravity of a given sample of fine aggregate.

Reference : IS : 2386 (Part III) – 1963

Apparatus: Pycnometer, A 1 000-ml measuring cylinder, well-ventilated oven, Taping rod, Filter papers and funnel, etc.

Figure:



Procedure:

1. A sample of about 500 g shall be placed in the tray and covered with distilled water at a temperature of 22 to 32°C. Soon after immersion, air entrapped in or bubbles on the surface of the aggregate shall be removed by gentle agitation with a rod. The sample shall remain immersed for 24 ± l/2 hours.
2. The water shall then be carefully drained from the sample, by decantation through a filter paper, any material retained being return& to the sample. The fine aggregate including any solid matter retained on the filter paper shall be exposed to a gentle current of warm air to evaporate surface moisture and the material just attains a _free-running‘ condition. The saturated and surface-dry sample shall be weighed (weight A).
3. The aggregate shall then be placed in the pycnometer which shall be filled with distilled water. Any trapped air shall be eliminated by rotating the pycnometer on its side, the hole

in the apex of the cone being covered with a finger. The pycnometer shall be dried on the outside and weighed (weight B).

4. The contents of the pycnometer shall be emptied into the tray, care being taken to ensure that all the aggregate is transferred. The pycnometer shall be refilled with distilled water to the same level as before, dried on the outside and weighed (weight C).
5. The water shall then be carefully drained from the sample by decantation through a filter paper and any material retained returned to the sample. The sample shall be placed in the oven in the tray at a temperature of 100 to 110°C for 24 f l/2 hours, during which period it shall be stirred occasionally to facilitate drying. It shall be cooled in the air-tight container and weighed (weight D).

Calculations:

Specific gravity, apparent specific gravity shall be calculated as follows:

Specific gravity = [D/{A-(B-C)}];

Apparent Specific gravity = [D/{D-(B-C)}]

A = weight in g of saturated surface - dry sample,

B = weight in g of pycnometer or gas jar containing sample and filled with distilled water,

C = weight in g of pycnometer or gas jar filled with distilled water only, and

D = weight in g of oven - dried sample.

Conclusion / Result: The Specific Gravity of a given sample of fine aggregate is found to be …….

Experiment No: 9 **Date:**

Title: Particle size distribution of fine aggregates

Objective: To determine fineness modulus of fine aggregate and classifications based on IS: 383-1970

Reference: IS : 2386 (Part I) – 1963, IS: 383-1970, IS : 460-1962

Theory: This is the name given to the operation of dividing a sample of aggregate into various fractions each consisting of particles of the same size. The sieve analysis is conducted to determine the particle size distribution in a sample of aggregate, which we call gradation. Many a time, fine aggregates are designated as coarse sand, medium sand and fine sand. These classifications do not give any precise meaning. What the supplier terms as fine sand may be really medium or even coarse sand. To avoid this ambiguity fineness modulus could be used as a yard stick to indicate the fineness of sand.
The following limits may be taken as guidance: Fine sand : Fineness Modulus : 2.2 - 2.6, Medium sand :

F.M. : 2.6 - 2.9, Coarse sand : F.M. : 2.9 - 3.2

Sand having a fineness modulus more than 3.2 will be unsuitable for making satisfactory concrete.

Apparatus: Test Sieves conforming to IS : 460-1962 Specification of 4.75 mm, 2.36 mm, 1.18 mm, 600 micron, 300 micron, 150 micron, Balance, Gauging Trowel, Stop Watch, etc.

Procedure:

1. The sample shall be brought to an air-dry condition before weighing and sieving. The air-dry sample shall be weighed and sieved successively on the appropriate sieves starting with the largest. Care shall be taken to ensure that the sieves are clean before use.
2. The shaking shall be done with a varied motion, backward sand forwards, left to right, circular clockwise and anti-clockwise, and with frequent jarring, so that the material is kept moving over the sieve surface in frequently changing directions.
3. Material shall not be forced through the sieve by hand pressure. Lumps of fine material, if present, may be broken by gentle pressure with fingers against the side of the sieve.
4. Light brushing with a fine camel hair brush may be used on the 150-micron and 75-micron IS Sieves to prevent aggregation of powder and blinding of apertures.

5. On completion of sieving, the material retained on each sieve, together with any material cleaned from the mesh, shall be weighed.

Observation :

I S Sieve	Weight Retained on Sieve (gms)	Percentage of Weight Retained (%)	Percentage of Weight Passing (%)	Cumulative Percentage of Passing (%)	Remark
4.75 mm					
2.36 mm					
1.18 mm					
600 micron					
300 micron					
150 micron					
Total					

Calculation: Fineness modulus is an empirical factor obtained by adding the cumulative percentages of aggregate retained on each of the standard sieves ranging from 4.75 mm to 150 micron and dividing this sum by an arbitrary number 100.
Fineness Modulus, FM = Total of Cumulative Percentage of Passing (%)/100

Conclusion / Result:
i) Fineness modulus of a given sample of fine aggregate is …….. that indicate Coarse sand/ Medium sand/ Fine sand.
ii) The given sample of fine aggregate is belong to Grading Zones I / II / III / IV

Table 3.15. Grading limits of fine aggregates IS: 383-1970

I.S. Sieve Designation	Percentage passing by weight for			
	Grading Zone I	Grading Zone II	Grading Zone III	Grading Zone IV
10 mm	100	100	100	100
4.75 mm	90–100	90–100	90–100	95–100
2.36 mm	60–95	75–100	85–100	95–100
1.18 mm	30–70	55–90	75–100	90–100
600 micron	15–34	35–59	60–79	80–100
300 micron	5–20	8–30	12–40	15–50
150 micron	0–10	0–10	0–10	0–15